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CAVITY FORMER

Field of the Invention

This invention relates generally to the formation of concrete slabs and foundations, and more particularly to structures for forming cavities or voids in a slab or foundation.

Background of the Invention

It is known to use cavity or void formers as space filling elements in the preparation of a concrete slab or foundation, for reducing the volume of concrete required to form the slab or foundation. Such foundations are commonly known as waffle slab foundations. While the reduction of concrete content in a slab as a result of having multiple cavities on its underside serves in turn to reduce the cost of the slab, it also advantageously allows the slab to be built on unstable soil as expanding soils will flow into the formed cavities. Such cavities also facilitate the placement of electrical and plumbing conduits through the slab.

As the cavity formers must be sufficiently strong to support, firstly, the weight of workers when the formers are in place prior to a pour and, secondly, the load of wet concrete when it is poured, the cavity formers are traditionally prefabricated remote from the building site in standard sizes and then delivered to the building site ready to be set in place prior to pouring of the concrete. Known cavity formers include reinforced multiple web-cardboard or fibreboard boxes and so called pods of foamed polymeric material, such as polystyrene.

Cardboard or fibreboard formers must have sufficient structural integrity to support a wet slab for a prescribed period, eg 3 hours, after a concrete pour, before they weaken through moisture absorption. Polystyrene pods overcome this limitation, but have the disadvantage that, when larger pods are cut into smaller shapes for filling cavities of irregular or smaller shape, large quantities of fine polystyrene particles are often generated. Such polystyrene particles present an environmental problem because they are easily scattered by a breeze. Furthermore, polystyrene pods do not disintegrate to more completely form the cavity or void and this presents a disposal and environmental problem when the slab is partially or wholly

demolished or reshaped. For these reasons, the use of polystyrene as a cavity former is being restricted in some locations.

Typically, slab formation preparations involve levelling the ground on which the slab is to be formed, erecting shutters to define the perimeter of the slab, locating reinforcement for edge beams of the building to be constructed, laying down building film, i.e. plastics sheets, onto the levelled ground, and then arranging multiple cavity formers in a spaced array on the building film. Bar chairs are then located at spaced intervals in the spaces between the cavity formers, and then reinforcement bars are placed on the bar chairs to form a lattice of reinforcement bar surrounding the cavity formers. Bar chairs are also located on the tops of the cavity formers to support reinforcement mesh that is laid in a blanket covering. After these preparations, the wet concrete is poured about the cavity formers, and cures to form the concrete slab or foundation. A process along these lines is described, for example, in Australian patent 584769 to Koukourou & Partners Pty Ltd.

The process of laying plastic sheets, arranging the cavity formers and bar chairs, and then accurately locating the bar and mesh reinforcement on the bar chairs is time consuming and inconvenient.

Australian petty patents 727681 and 727665 disclose cavity former modules fabricated in recycled plastic. The modules have multiple box elements joined in an integral structure that also defines channels between the box elements. Reinforcing bars are supported in the channels on spaced integral bracket elements that each have an upper edge shaped to center the bar, while reinforcing mesh rests on upstanding ribs formed integrally on the top surfaces of the box elements. Applicant has found that, while cavity former modules of this kind alleviate the environmental concerns of polystyrene pods and address the labour costs of foundation preparation, the modules require a volume of plastic that adversely affects their economics relative to cardboard and polystyrene. They are also bulky to transport.

Reference herein to any specific prior document is not to be taken as an admission or suggestion that the contents of the document constitute common general knowledge.

It is an object of this invention to provide an improved cavity former which embodies a satisfactory compromise between various cost, handling and environmental considerations.

Summary of the Invention

In a first aspect, the invention provides a cavity former for forming one or more cavities in a concrete slab, including:

a hollow body about which, during use of the former, poured concrete flows and subsequently cures to form a concrete slab in which the hollow body defines a cavity;

wherein said hollow body has a first wall, a depending skirt wall about the periphery of the first wall, and structure defining, within said periphery, at least one depending hollow pillar formation for in situ bracing said first wall to an underlying surface on which said skirt wall also rests.

In one embodiment, said structure comprises a plurality of valleys in said first wall that define said at least one hollow pillar formation at their intersection. In another embodiment, said structure comprises a hollow tubular structure which constitutes said pillar formation and preferably has its interior open at said first wall.

In a second aspect, the invention provides a cavity former for forming one or more cavities in a concrete slab, including:

a hollow body about which, during use of the former, poured concrete flows and subsequently cures to form a concrete slab in which the hollow body defines a cavity;

wherein said hollow body has a first wall, and a depending skirt wall about the periphery of the first wall, and is configured to allow nesting of said

cavity former with a second similar cavity former, and thereby to allow stacking of a multiplicity of said cavity formers.

Preferably, a cavity former according to the second aspect of the invention is also in accordance with the first aspect, said skirt wall and said structure defining the hollow pillar formation being tapered to nest with the like features of a similar cavity former.

The invention further provides, in a third aspect, a cavity former for forming one or more cavities in a concrete slab, including:

a hollow body about which, during use of the former, poured concrete flows and subsequently cures to form a concrete slab in which the hollow body defines a cavity;

wherein said hollow body has a first wall, a depending skirt wall about he periphery of the first wall, and a pair of intersecting upstanding ribs formed integrally on the outer surface of said first wall for supporting reinforcing mesh above said hollow body.

The ribs are preferably a pair of crossed ribs.

In a further, fourth, aspect of the invention, there is provided a cavity former for forming one or more cavities in a concrete slab, including:

a hollow body about which, during use of the former, poured concrete flows and subsequently cures to form a concrete slab in which the hollow body defines a cavity;

wherein said skirt wall includes at least one outstanding, preferably upstanding, tab for interlocking with a skirt wall of a similar cavity former and thereby to inhibit relative movement of individual cavity formers during pouring of the wet concrete.

In the fourth aspect, such interlocking is preferably such that the plural interlocked cavity formers provide a moisture barrier between the concrete and an underlying ground surface.

The hollow body may be a rectangular pod open on a lowermost side. In an embodiment, the cavity former has a plurality of hollow bodies or pods spaced apart by integrally formed channels that receive elongated slab-reinforcement. The supports are preferably arranged and spaced so that if the mesh reinforcement is randomly dropped onto an array of cavity formers, the mesh reinforcement will rest on the supports above the bodies. Seats may be integrally formed in the channels to link adjacent pods and to support the elongated slab reinforcement located in the channel. Preferably, the seats automatically center the elongated slab-reinforcement longitudinally within the respective channel.

The support for the slab reinforcement is preferably shaped (eg. parabolic) to enable automatic centering of the slab-reinforcement within the channels.

Preferably, the supports for the mesh, in a cavity former including a plurality of bodies, are arranged and spaced to cover a corresponding location on each body. The supports may be located on the corresponding separable compartment of each body.

Brief Description of the drawings

The invention will now be further described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a pair of coupled four-pod cavity formers, embodying several aspects of the invention and partially laid out with reinforcement bar and mesh in preparation for wet concrete to be poured to form a concrete waffle slab foundation with cavities defined by the pods of the cavity formers;

Figure 2 is a cross-section of one of the cavity formers shown in Figure 1 along the line 2-2, shown in a nesting configuration with a similar cavity former shown in dashed lines;

Figure 3 is a view similar to Figure 2 but showing one of the cavity formers in full lines, and the other in dashed lines;

Figure 4 is a plan view of one of the cavity formers; and

Figures 5 and 6 illustrate (with only two pods shown) an alternative structure for providing a pod with a central hollow pillar, Figure 6 being a cross-section on the line 6-6 in Figure 5.

Detailed description of embodiments of the Invention

Figure 1 shows a pair of four-pod cavity formers 10 arranged with reinforcing products, such as reinforcement mesh 12 and reinforcement bar 14, supported by the cavity formers 10, in preparation for pouring of wet concrete to form a slab foundation. Each cavity former 10 includes four hollow bodies, ie. pods, 20, arranged in a rectangular configuration and separated by channels in the form of orthogonal intersecting trenches 40. It will be appreciated that the wet concrete is poured about the cavity formers such that the cured concrete slab has cavities or voids defined by the respective pods 20.

The pods 20 and trenches 40 are integrally formed to space the pods 20 apart such that reinforcement bar 14 is receivable within the trenches 40 to reinforce the formed concrete slab. The integrally formed cavity formers 10 comprising pods 20 and trenches 40 are moulded in any appropriate plastics or other suitable material. A suitable material is a recycled polypropylene, virgin or recycled. Other possible alternates include polyethylene, cross-linked polyethylene and PET. The material is preferably selected to provide an effective moisture barrier, as well as the necessary structural properties.

Each pod 20 includes a first, planar top wall 27 and a depending skirt wall 22 about the periphery of wall 27. Wall 27 is normally horizontal in situ and has a top surface 28 on which is provided an integrally formed support, in the form of a pair of hollow outstanding ribs 30, for supporting reinforcement mesh 12 placed on the cavity former 10. Reinforcement mesh 12 supported on the ribs 30 is held in a spaced relationship above the pod 20. The ribs 30 intersect to define a cruciform shape such that the reinforcement mesh 12 is supported above the pod 20 for any given orientation of the mesh 12 relative to the pod 20, whereby reinforcement mesh randomly dropped onto an array of the cavity formers will rest on the

supports above the bodies of the cavity formers, without any need for separate bar chairs on the pods.

Peripheral skirt walls 22 taper downwardly and outwardly relative to top surface 28 such that multiple cavity formers 10 may nest, when stacked, to provide a reduced volume to facilitate transport to a construction site. Nesting is further aided by the ridges 30 being hollow in order to receive the ridges 30' of an underlying nesting cavity former 10' (Figure 2).

Intersecting minor channels, in the form of valleys 24, are formed in each pod to provide separate hollow compartments 26 and to define, within peripheral skirt wall 22 and at the centre of the pod, a tapered hollow depending pillar formation 25 for in situ bracing wall 27 to an underlying surface on which the skirt wall 22 also rests. Pillar formation 25 comprises the four intersecting corners of the side walls of valleys 24, bounding a cavity 31 open at 33 in top wall 27. This structure provides the pods with greater strength for supporting the weight of workers prior to the wet concrete being poured, the mesh when laid and the weight of wet concrete once poured.

The compartments 26 are selectively separable from pods 20 at valleys 24 to customise the shape of the cavity former 10 as required. The valleys 24 extend the height of the walls 22 to ensure that the ability of the compartments 26, remaining after one or more compartments 26 have been removed, to form cavities in the poured concrete is not compromised. While the valleys 24 are arranged in a cruciform shape, it will be appreciated that the valleys 24 may be arranged in other configurations to provide differently shaped separable compartments 26.

Figures 5 and 6, in which like features are indicated by like primed reference numerals, illustrate an alternative structure for defining hollow pillar formation 25' in each pod 20', ie. a hollow tapered tubular structure with its interior cavity 31' open at 33' in wall 27'.

The underside or interior of each pod 20 may typically include integral fins 39 (Figures 2 and 3), corrugations or other formations for increasing the strength and rigidity of the pod.

It will be appreciated that the presence of pillar formation 25, 25', and the provision of strengthening fins 39 and the like, allows wall thickness, and thereby material usage per pod, to be kept as small as possible.

The support ribs 30 are arranged and spaced to be located at a corresponding compartment 26 on each pod 20. In Figures 1 and 4, the supports are shown on corresponding separable compartments 26 of each pod 20.

An alternative embodiment of cavity former 10 comprises a single pod 20 and integrated crossed ribs 30 as described above with or without the valleys 24. This embodiment has the same advantages as described above, i.e. enabling the reinforcement mesh to be supported on the pod 20 in any orientation relative to the cavity former 10 and avoiding the necessity for separate bar chairs to support the mesh.

The pods 20 are linked by seats for supporting reinforcement bar 14. The seats are integrally formed in the trenches 40. In one embodiment (not illustrated), the seats are provided by the floor of the trench 40 having a shape, eg. parabolic, that automatically aligns and centers the reinforcement bar 14 longitudinally within the trench 40. In the preferred embodiment, as illustrated, however, the seats are provided in the form of saddles 42 integrally formed in the trenches 40 to link opposed pods 20 (Figures 2 and 4). The top edge 43 of each saddle 42, is formed with a parabolic shape to enable automatic centering of a reinforcement bar dropped into the trenches 40.

The saddles 42 respectively located in the perpendicularly arranged trenches 40 are vertically offset to ensure that reinforcement bar 14 in one trench 40 does not interfere with reinforcement bar 14' located in a perpendicular trench 40 at the point where the trenches 40 intersect.

While the upper edges of saddles 42 may have a parabolic profile, it will be appreciated that any other shape suitable for automatically centering

reinforcement bar 14 in a trench 40 may alternatively be adopted. For example, the saddles may have a v-shaped profile spanning substantially the whole width of the trenches 40.

A pair of upwardly turned tabs 50 are located on two adjacent sides of the cavity former 10 to interlock adjacently arranged cavity formers in situ (Figure 3). By interlocking adjacent cavity formers 10 together, individual cavity formers 10 are prevented from relatively shifting during the pouring of the wet concrete. Accordingly, the cavity formers of an array of interlocked cavity formers 10 maintain their original positioning during the concrete pour.

Rounded depressions 52 are formed in the upper sides of one or more of the pods 20 to provide hook points for attachments to lift the cavity former 10 or a plurality of nesting cavity formers 10 when they are upturned. Typically, nesting cavity formers 10 are turned upside down for transport as the ribs 30 on the lowermost cavity former 10 provide a clearance between the upper surface 28 of the pods 20 and the ground. This clearance enables suitable lifting means, such as a fork lift, to slide underneath the nesting cavity formers 12 and pick them up.

Slab formation preparations, using the cavity formers 10, involve first delivering a required number of the cavity formers 10, in a nested stack, to the construction site. At the construction site, the ground on which the slab is to be formed is levelled and prepared, shutters are erected to define the perimeter of the slab, and reinforcement elements are positioned for edge beams of the building to be constructed. One or two workers then place individual cavity formers 10 in an array on the levelled ground such that they are interlocked by the upturned tabs 50. Customised shaping of some cavity formers 10 may be necessary at the margins of the slab site. The interlocked cavity formers 10 should provide blanket coverage over the levelled ground such that, during pouring and curing, the ground is not exposed to the wet concrete: the cavity formers are thereby able to take the place of traditional ground sheeting both in its short term role in containing moisture within the concrete gel matrix during curing of the concrete, and in its longer term role as a vapour barrier between the ground and the finished slab during the life of the slab.

Once positioned, the trenches 40 of adjacent cavity formers 10 will be in alignment, thereby enabling reinforcement bar 14 to be dropped directly into the trenches for automatic centering on saddles 42. Accordingly, separate spacers are not required to achieve the correct spacing between adjacent pods 20 and, moreover, the use and positioning of bar chairs in the trenches 40 is not required. Substantial time is thereby saved in preparing for the wet concrete to be poured.

Reinforcement mesh 12 is then located on the cavity formers 10 for support by the ribs 30. As the cruciform arrangement of the ribs 30 enables the reinforcement mesh 12 to be located on the cavity formers in any orientation relative thereto, more time is saved because neither bar chairs nor specific mesh orientations are required.

Typically the cavity formers 10 are square and having side lengths in the range of 800-1600 millimetres, but preferably 1000-1200 millimetres. They may be formed with a height in the range of 150-400 millimetres, but specifically may be fabricated with 175, 225, 300 or 375 millimetre heights for different slab depths. The cavity formers 10 are composed of a suitable plastics material to support the weight of wet concrete bearing down on the cavity former during curing, or the weight of a person standing on the cavity former. For example, the cavity formers are formed to support a 150 kilogram point load. For the concrete curing process, the cavity formers 10 are able to support about 280 kilograms per square metre.